Amendments to the Drawings:

The attached sheet of drawings includes changes to Figure 1. This sheet, which includes Figure 1 replaces the original sheet which included Figure 1.

Attachment: Replacement Sheet (1)

REMARKS/ARGUMENTS

Claims 31-33 and 35-60 are pending in the present application. Claims 31 and 56 have been amended by this Amendment. Claim 34 has been canceled without prejudice or disclaimer.

Drawings/Specification

The Examiner objects to the drawings because a heat pump is specified in the claims, but the heat pump is not shown in the drawings. Applicants submit herewith amended Figure 1 showing the heat pump labeled with reference number 12. The specification has been amended to include the reference to the label number of the heat pump.

Claim Rejections under 35 USC § 102 and 35 USC § 103

Claims 31-43, 46, 47, 49-56 and 58-60 stand rejected under 35 USC § 102(b) as anticipated by Lazarevich (U.S. Pat. No. 4,848,088). Claims 44, 45 and 57 stand rejected under 35 USC § 103(a) as unpatentable over Lazarevich in view of Lawheed (U.S. Pub. No. 2003/0172654). Claim 48 stands rejected under 35 USC § 103(a) as unpatentable over Lazarevich in view of Kim (U.S. Pat. No. 6,237,340). Applicants traverse these rejections.

Claim 31 has been amended to recite, *inter alia*, "the working fluid is an azeotropic mixture." Support for this amendment is found in Applicants' original claim 34 and in paragraph [0029] of the published version of the present application (US 2008/0289336). The cited references fail to disclose a working fluid that is an azeotropic mixture as explicitly recited by Applicants' amended claim 31.

Discussion of Disclosed Embodiments

The following descriptive details are based on the specification. They are provided only for the convenience of the Examiner as part of the discussion presented herein, and are not intended to argue limitations which are unclaimed.

Applicants' disclosed embodiments are directed to a method and apparatus for converting heat energy to mechanical energy. An evaporated working fluid is expanded with an expansion device 2 connected to an evaporator 6. The energy contained in the expanded evaporated working fluid is recycled into the evaporator 6 and used to evaporate additional working fluid. Applicants' published application explains at paragraph [0028] that the working fluid is an azeotropic mixture. The evaporation temperature of the azeotropic mixture is lowered to be below the evaporation temperatures of the individual components of the azeotropic mixture. For example, as disclosed at paragraph [0029] of Applicants' specification, the azeotropic mixture may be a mixture of pyridine and water. The boiling point of pyridine is 115 degrees Celsius and the boiling point of water is 100 degrees Celsius. However, the boiling point of an azeotropic mixture of pyridine 57% and water 43% is 92.6 degrees Celsius. As such, it is not possible to evaporate one component from the other in an azeotropic mixture. Therefore, there is less energy necessary to evaporate the mixture because the boiling point of an azeotropic mixture is lowered. Thus, the conversion of heat energy into mechanical energy is more efficient because the evaporation energy of the mixture is lowered.

Arguments

Lazarevich describes a process and apparatus for generating low temperature, low pressure energy from the vaporization of a primary fluid. Lazarevich discloses at col. 3, line 57 through col. 4, line 14 that the primary fluid is water that is turned to steam in a steam generator to drive turbines to produce mechanical energy. The steam is then condensed in a condenser 3 in which the latent heat of vaporization of the steam is transferred to a heat recycling fluid to separate at least some of the solute therefrom. Lazarevich discloses at col. 4, lines 15-21 that the heat recycling fluid consists of two basic constituents in the form of a solute and a solvent, i.e., anhydrous ammonia and water. As described at col. 4, lines 22-37 of Lazarevich, the heat recycling fluid takes up the latent heat of vaporization from the working steam of the primary fluid which separates at least some of the solute from the remainder of the heat recycling fluid thereby condensing the steam. That is, the ammonia evaporates from the water to abstract thermal energy from the primary fluid, which is condensed afterwards. The separated constituents of the heat recycling fluid, a principally solute steam and a principally solvent steam, are forced back in solution by an ejector 4, and then the heat of the recycling fluid is transferred back to the primary fluid by heat exchangers 5.

The Examiner asserts at page 3 of the Office Action that the recycling fluid of Lazarevich is a working fluid that is a mixture including a first component and a second component where the first component is evaporable and absorbable by the second component. However, the recycling fluid of Lazarevich <u>cannot</u> be considered to be the claimed working fluid because the recycling fluid of Lazarevich is not an azeotropic mixture.

An azeotropic mixture exhibits a single, unique boiling point and, thus, it is not possible to evaporate one component from the other in an azeotropic mixture. Therefore, the mixture of Lazarevich cannot be an azeotropic mixture. On the contrary, as noted above and as already

acknowledged by the Examiner, the recycling fluid of Lazarevich takes up the latent heat of vaporization from the working steam of the primary fluid to separate at least some of the solute from the remainder of the recycling fluid. Moreover, Lazarevich describes that the working fluid consists of anhydrous ammonia and water. Ammonia and water form a zeotropic mixture at every concentration, and not an azeotropic mixture. Accordingly, Lazarevich fails to disclose, teach or suggest that "the working fluid is an azeotropic mixture", as recited by Applicants' amended claim 31.

Furthermore, the recycling fluid cannot be considered to be the claimed working fluid because Lazarevich explains that the primary fluid consisting of water is used to drive the turbines. The recycling fluid of Lazarevich is not expanded in a low-pressure expansion device. One skilled in the art would look to use only water as a working fluid that is expanded in a turbine after reading Lazarevich. Thus, Lazarevich fails to even provide a reason for the skilled artisan to use the recycling fluid as a working fluid that is expanded in a low-pressure expansion device.

Even assuming, *arguendo*, the propriety of the Examiner's proffered combination of Lazarevich, Lawheed and/or Kim (which Applicants do not concede), Lawheed and Kim fail to cure the deficiencies of Lazarevich discussed above with respect to claim 31.

Lawheed describes a system for converting solar energy to thermal energy and for converting the resultant thermal energy to electrical energy using a Rankine cycle mechanism to drive an electrical generator. (see Abstract of Lawheed). Lawheed discloses at paragraph [0043] a low temperature heated liquid may be passed along a closed loop through a heat exchanger where heat is transferred from the liquid to a gas which, in turn, is displaced along another closed loop through the Rankine cycle mechanism. However, Lawheed fails to identify an azeotropic

mixture, and provides no reason for the skilled artisan to employ an azeotropic mixture in the process in Lazarevich. On the contrary, the cycle medium in Lawheed is transferred from the vapor state to the liquid state as a single, unique medium, and not as a mixture. An azeotropic mixture does not liquidate as a single, unique medium but, rather, as the mixture. Therefore, Lawheed provides the skilled artisan no reason to use an azeotropic mixture in the process in Lazarevich.

Kim is directed to a method of reusing expansion energy by repeating chemical bonding and, thus, likewise fails to cure the deficiencies of Lazarevich discussed above with respect to claim 31.

Accordingly, independent claim 31 is deemed to be patentably distinct over the cited art for at least the foregoing reasons. Independent claim 56 contains features akin to those discussed above with respect to claim 31 and, therefore, claim 56 is likewise deemed to be patentably distinct over the cited art for at least the same reasons as claim 31. Claims 32, 33, 35-55 and 57-60, which variously depend from one of claims 31 and 56, are deemed to be patentably distinct over the cited art for at least the same reasons discussed above with respect to claims 31 and 56, as well as on their own merits.

Additional Cited Art

Applicants now address the cited references made of record and not relied upon by the Examiner. Lohmiller (U.S. Pat. No. 4,292,808), Ishida et al. (U.S. Pat. No. 5,007,240, hereinafter "Ishida"), Brinkerhoff (U.S. Pat. No. 4,195,485), Hashiguchi (U.S. Pat. No. 5,754,613, Katayama (U.S. Pat. No. 6,460,338), and Roe (U.S. Pat. No. 1,961,787) likewise fail to disclose, teach or

suggest that "the working fluid is an azeotropic mixture", as recited by Applicants' independent claims 31 and 56.

Lohmiller is directed to an energy converting system for converting low temperature heat energy into mechanical energy. Lohmiller discloses at col. 2, lines 18-21 that the energy converting system 10 includes a carrier fluid 12 that comprises water and a compressible working medium 14, absorbable in the carrier fluid, that comprises ammonia. Lohmiller discloses at col. 2, lines 30-41 that an evaporator or evaporator means 18 evaporates the ammonia from a liquid state to a gaseous state. The gaseous ammonia passes from the evaporator 18 through a conduit 20 into an absorber or absorption means 22. In the absorber 22, the gaseous ammonia comes in contact with the water, and the water is sprayed into the chamber of gaseous ammonia so that the water absorbs the ammonia to provide the concentrated mixture of ammonia in water. Therefore, the mixture of Lohmiller is the same as the mixture of Lazarevich, i.e., ammonia and water. As noted above, ammonia and water form a zeotropic mixture. Therefore, Lohmiller fails to disclose, teach or suggest that "the working fluid is an azeotropic mixture", as recited by Applicants' independent claims 31 and 56.

Ishida describes a hybrid Rankine cycle system which uses an absorbent solution consisting of two components. Ishida discloses at col. 3, lines 55-58 that a water-lithium bromide (LiBr) solution, a water-lithium chloride (LiCl) solution or a water-potassium hydroxide (KOH) solution is suitably used as the absorbent solution. The absorbent solution of Ishida is heated in a boiler to evaporate the water to steam to drive a turbine. Afterwards, the steam is absorbed by the remaining absorbent solution. As noted above, it is not possible to evaporate one component from the other in an azeotropic mixture and, therefore, the absorbent solution of Ishida is not an

azeotropic mixture. Accordingly, Ishida fails to disclose, teach or suggest that "the working fluid is an azeotropic mixture", as recited by Applicants' independent claims 31 and 56.

Brinkerhoff is directed to a distillation/absorption engine including an apparatus for utilizing a lower boiling point, working fluid and a higher boiling point, and absorption fluid, the absorption fluid having a relatively high degree of absorption for the working fluid. The engine comprises a distiller, which separates the working fluid from the absorption fluid, a condenser/storage system for storage of the separated working fluid and a heater to boil the working fluid, which drives a turbine. (see Abstract of Brinkerhoff). Therefore, the distiller and condenser means of Brinkerhoff require that the absorption fluid absorb the relaxed working fluid. The working fluid of Brinkerhoff is not an azeotropic mixture. Brinkerhoff fails to identify or delineate the composition of the working fluid and the composition of the absorption fluid. Accordingly, Brinkerhoff fails to disclose, teach or suggest that "the working fluid is an azeotropic mixture", as recited by Applicants' independent claims 31 and 56.

Hashiguchi is directed to a power plant that comprises a steam system and a mixed medium system. Hashiguchi discloses at col. 6, lines 1-9 that the mixed medium flowing through the inside of the intra-condenser heat exchange element 13 is a medium which contains two or more components. At least one of these components constituting the mixed medium of Hashiguchi is a substance having a boiling point lower than that of water (a lower boiling point component). In particular, Hashiguchi discloses at col. 6, lines 8-9 that the mixed medium is a mixture of at least water and ammonia. Therefore, Hashiguchi is likewise directed to a zeotropic mixture, and <u>not</u> an azeotropic mixture. Accordingly, Hashiguchi fails to disclose, teach or suggest that "the working fluid is an azeotropic mixture", as recited by Applicants' independent claims 31 and 56.

Katayama describes an absorption waste-heath recovery system including an evaporator with an absorber, which heats a water solution to steam to drive a high temperature generator. The steam is liquefied in a condenser, which supplies the evaporator with water. (see Abstract of Katayama). Katayama also discloses at col. 9, lines 10-13 an absorbing liquid that comprises a water solution of lithium bromide as an absorbent. Katayama fails to disclose, teach or suggest that the lithium bromide and water form an azeotropic mixture as explicitly recited by Applicants' independent claims 31 and 56.

Roe is directed to a power plant which employs a binary fluid regenerative heat cycle. Roe discloses at col. 1, lines 17-23 that the binary fluid consists of two liquids (a heavy liquid and a light liquid), one of which has a lower boiling point than the other. Each of the heavy liquid and the liquid exhibit their own cycle and are brought together by a condenser and separated by a separator. Roe fails to identify or delineate an azeotropic mixture as the binary fluid. Accordingly, Roe fails to disclose, teach or suggest that "the working fluid is an azeotropic mixture", as recited by Applicants' independent claims 31 and 56.

Accordingly, each of the cited references made of record and not relied upon by the Examiner suggest using a mixture of two components where the first component is evaporated out of the second component and is afterwards absorbed by the second component. As previously noted, an azeotropic mixture exhibits a single, unique boiling point and, thus, it is not possible to evaporate the first component from the second component in an azeotropic mixture. Therefore, none of the additional references made of record by the Examiner cure the deficiencies of Lazarevich, Lawheed and Kim discussed above with respect to Applicants' amended claim 31.

CONCLUSION

For all of the above reasons, Applicants request that the rejections under 35 USC § 102(b) and 35 USC § 103(a) be withdrawn.

This application is now believed to be in condition for allowance, and early notice to that effect is solicited.

It is believed that no fees or charges are required at this time in connection with the present application. However, if any fees or charges are required at this time, they may be charged to our Patent and Trademark Office Deposit Account No. 03-2412.

Respectfully submitted,
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